

Rotatoria and Crustacea fauna of the Hungarian watercourses

by

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Abstract: In this paper summary is given on the results of zooplankton research on the River Tisza and its tributaries, and on the Transdanubian watercourses. In the period of 1992-1994 altogether 43 Hungarian streams were investigated at 103 sampling sites, 259 Rotatoria, 47 Cladocera and 17 Copepoda taxa were recorded. Attached fauna list contains species occurrence data, faunistic and ecological evaluation is focussed on the River Tisza. Our studies revealed the occurrence of 19 Rotatoria species new to the fauna of Hungary.

Key words: Rotatoria, Cladocera, Copepoda, River Tisza and its tributaries, Transdanubian waterways

Literature survey

Literature survey of the earlier zooplankton research revealed that the River Tisza and its tributaries, dead arms were extensively studied while the Transdanubian rivers and streams were largely neglected. Detailed zooplankton studies were conducted on stagnant waters and especially on the Lake Balaton.

First papers on the Tisza were published by Daday (1888, 1891) and Éber (1955). Studies on loam pit lakes were published by Varga (1928, 1930). Most detailed investigations on the Tisza and its tributaries were issued by Megyeri (1955, 1957, 1959, 1961, 1970, 1971, 1972). On the middle Tisza section Gál (1963) and Bancsi (1976b, 1977) published results, while sediment dwelling Rotatoria and Entomostraca fauna was described by Bancsi & Hamar (1981) and Zsuga (1981).

There are many papers published on smaller streams, dead-arms, inland waters belonging to the Tisza watershed (Varga 1931, 1953, 1966, Bancsi 1974a, b, 1975, 1976a, c, 1980, Zsuga & Nagy 1989, Zsuga & Nagy 1991). Water quality problems of the watershed and ecological effects of the Kisköre reservoir were discussed by Adámosi *et al.* (1974, 1978), as well as by Bancsi & Végvári (1990).

Rotatoria and Entomostraca fauna of the Transdanubian rivers were studied earlier by Jaczó (1939), Varga (1938, 1945) and Woynarovich (1944).

Material and methods

Investigation of the zooplankton of the River Tisza and its tributaries and of Transdanubian watercourses was conducted in the framework of a large survey program in 1992-1994. Altogether 43 waterways were investigated at 103 sampling sites. Samples were taken from the middle river section in order to have a representative sample for that particular site. Sample collection was done from ships, ferries, bridges, and different hydraulic constructions. In the case of smaller, shallow streams occasionally sediment dwelling animals were collected deliberately. Sample collection period covered

all year throughout the three years of the investigations from February until November. Frequency of sampling was set to take into account seasonal changes as well as the differences of hydrological regimes, with particular interest to small water periods in summer.

Samples were taken from the surface and were filtered by a 60 μm mesh size plankton net. Volume of filtered water was between 10-50 liters. The filtrate was conserved on-site by using 40% formaldehyde solution to reach 4% final concentration, occasionally lugol (iodine) solution was also used for conservation.

Animals were determined using the identification keys by Bancsi (1986, 1988), Gulyás (1974), and Dévai (1977). Taxa lists were prepared on the basis of these manuals (see Appendix). Quantitative samples were counted by using Utermöhl plankton counter microscope, with 1 and 5 ml counting chambers. Abundance and wet biomass were determined according to Bottrell *et al.* (1976) and Ivanova (1985).

Investigated watercourses and sampling locations were the following:

1. **Tisza:** Tiszabecs, Vásárosnamény, Záhony, Balsa, Tiszalök, Polgár, Tiszafüred, Kisköre, Szolnok, Tiszaug, Mindszent, Tiszasziget
2. **Túr:** Kishódos
3. **Szamos:** Csenger
4. **Kraszna:** Mérk
5. **Lónyai csatorna:** Buj
6. **Bodrog:** Felsőberecki, Tokaj
7. **Hernád:** Hernádszurdok, Gesztely
8. **Bódva:** Hídvégardó, Borsodszirák
9. **Hangony:** Center
10. **Jósza:** Szín
11. **Sajó:** Sajópuspöki, Miskolc, Alsózsolca, Kesznyéten
12. **Eger-patak:** Négyes
13. **Tarna:** Verpelét
14. **Zagyva:** Nagybátony, Jásztelek, Újszász
15. **Hortobágy:** Hortobágy
16. **Hortobágy-Berettyó:** Mezőtúr
17. **Kösel:** Nádudvar
18. **Berettyó:** Pocsaj, Szeghalom
19. **Sebes-Körös:** Körösszakál, Körösladány
20. **Fekete-Körös:** Sarkad
21. **Fehér-Körös:** Gyulavári
22. **Kettős-Körös:** Mezőberény
23. **Hármas-Körös:** Gyoma, Magyartés
24. **Maros:** Makó
25. **Main Eastern Canal:** Balmazújváros, Bakonszeg
26. **Main Western Canal:** újszentmargita
27. **Main Nagykunság Canal:** Fegyvernek
28. **Rába:** Szentgotthárd, Csörötnök, Körmend, Rum, Sárvár, Ostffyasszonyfa, őrpás, Győr
29. **Répcse:** Répcevis, Nagygeresd, Kapuvár-Hövej
30. **Rábca:** Győrsövényház, Győr
31. **Marcal:** Karakó, Mórchida
32. **Lajta:** Mosonmagyaróvár
33. **Concó:** M1 highway, Ács Motorway 10
34. **Általér:** Pusztavám, Kecskéd, Vértesszőlős, Tata, Dunaalmás
35. **Séd-Nádor csatorna:** Úrhida, Cece, Sióagárd
36. **Sió:** Siófok, Mezőkomárom, Simontornya, Szekszárd Motorway 6
37. **Kapos:** Kaposújlak, downstream Kaposvár, Dombóvár, Kurd, Pincehely
38. **Dráva:** Őrtilos, Barcs, Drávaszabolcs
39. **Mura:** Letenye
40. **Rinya:** Babócsa
41. **Kerka:** Lenti, Tornyiszentmiklós
42. **Zala:** Zalalövő, Andrásida, Alibánfa, Zalaapáti, Fenékpusztá
43. **Mosoni-Danube:** Rajka, Feketeerdő, Mosonmagyaróvár, Mecsér, Győr, Győr downstream of wastewater treatment plant, Vének

Evaluation of the results

Investigations revealed the occurrence of 259 Rotatoria, 47 Cladocera and 17 Copepoda taxa. From these 19 rotifer species were new for the fauna of Hungary (Table 1), and 59 rare Rotatoria, and 7 rare Cladocera species were found.

Table 1. List of Rotatoria species new for the fauna of Hungary. Numbers indicate localities

<i>Brachionus nilsoni</i> Ahlstrom: 2, 4, 8, 11, 17, 20	<i>Filinia cornuta monoarhtra</i> (Sokolova): 1, 24
<i>Cephalodella biungulata</i> Wulfert: 1, 2, 3, 4, 5, 7, 8, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26	<i>Filinia minuta</i> (Smirnow): 1
<i>Cephalodella obvia</i> (Donner): 18, 22	<i>Lecane inopinata</i> Harring & Myers: 8, 11
<i>Dicranophorus robustus</i> (Harring & Myers): 17	<i>Lecane ohioensis</i> (Herrick): 16
<i>Encentrum eurycephalum</i> (Wulfert): 1, 6, 7, 9, 11	<i>Proales doliaris</i> (Rousselet): 1, 2
<i>Encentrum glaucum</i> (Wulfert): 8	<i>Proales theodora</i> (Gosse): 2, 3, 7, 8, 9, 11, 19, 23, 26, 27
<i>Encentrum martes</i> (Wulfert): 7, 9	<i>Pseudoharringtonia similis</i> Fadeev: 11, 14,
<i>Encentrum oculatum</i> (Harring & Myers): 18	<i>Ptygura melicerta</i> (Ehrenberg): 16, 19
<i>Encentrum orthodactylum</i> (Wulfert): 1, 3, 11, 18, 19, 26	<i>Taphrocampa selenura</i> Gosse: 18, 19, 23, 25
	<i>Trichotria curta</i> (Skorikov): 1, 2, 3, 8, 11, 18, 2

Detailed characterization of Rotatoria and Crustacea fauna

1. Tisza River

In general, the river is characterized by the dominance of plankton organisms. The large number of occurring taxa (altogether 128 *Rotatoria*, 16 *Cladocera* and 5 *Copepoda*) is worth noticing. Species richness of the Tisza is 2-5 times higher than that of the other streams of the watershed. The zooplankton fauna of the Tisza is characterized by euplanktonic organisms, many of are them cosmopolitan, adaptable species. On the basis of the quantitative and qualitative composition of the zooplankton several river sections can be distinguished. Between Tiszabecs and Záhony low abundance and species number are characteristic. Between Tiszalök and Kisköre a rich zooplankton community develops due to the effect of the reservoir. At the river section from Szolnok to Tápé, the zooplankton community shows the usual seasonal changes. On the basis of the frequency of occurrence the following species can be considered as endogenic plankton elements: *Anuraeopsis fissa*, *Brachionus angularis*, *B. budapestinensis*, *B. calyciflorus*, f. *amphiceros*, *Filinia longiseta*, *Keratella cochlearis*, *K. cochlearis tecta*, *Polyarthra dolichoptera*, *Synchaeta tremula*, *Trichocerca pusilla*, *Bosmina longirostris*, *Daphnia longispina*, *Diaphanosoma brachyurum*, *Eucyclops serrulatus*, *Eudiaptomus gracilis*.

Based on the zooplankton investigations the upper section of the Tisza (Tiszabecs, Záhony) is mesotrophic, downstream eutrophic, but occasionally eupolytrophic state can also occur in the impounded sections. Water quality of the river is beta, alpha-beta mesosaprobic, during flood periods alpha-mesosaprobic states can be observed. In low water periods the effects of the tributaries are evident in case of Szamos and Maros Rivers. The River Sajó, opposite to the literature data has only minor influence on the zooplankton composition of the Tisza. Effect of the other tributaries was not detected, no significant alterations could be measured at confluences in general.

Zooplankton biomass at the upper Tisza section ranged between 0.01 – 6.87 g/m³. At Balsa and Tiszalök the measured range was 0.01 – 41.23 g/m³, large values were characteristic during low flow, summer periods due to the effect of the Szamos and impoundment. In the impounded section at Kisköre the values varied between 0.01 – 20.39 g/m³. In the middle river section (Szolnok-Mindszent) biomass values 0.01 – 7.29 g/m³ were measured, while in the lower reach 0.03 – 49.62 g/m³ values were determined.

2. Túr

57 Rotatoria and 2 Cladocera taxa were found, the dominance of planktonic eutrophic elements were characteristic (*Brachionus*, *Cephalodella*, *Synchaeta*, *Trichocerca* genera). As a result of high water velocities species number and biomass was low, the latter changed between 0.01 – 0.24 g/m³.

3. Szamos

59 Rotatoria taxa occurred here, the microcrustacean fauna was rather poor. On the Tisza watershed this is one of the most polluted streams. Large quantities of organic and inorganic pollutants are carried by this river into the Tisza causing extreme water quality conditions (alpha-mesosaprobic state), especially with regards to dissolved oxygen content. These conditions might have been caused by the low water and warm weather as well. Zooplankton biomass values in the Szamos in 1992 were 0.01 – 67.36 g/m³, which is extremely high considering the whole watershed, and are characteristic to eupolytrophic, polytrophic stagnant waters. Large biomass is due to *Anuraeopsis fissa*, *Filinia longiseta*, *Trichocerca pusilla*, *Polyarthra vulgaris*, and *Brachionus* and *Keratella* species.

4. Kraszna

Belongs to polluted watercourses. From the 59 taxa of *Rotatoria* fauna dominance of cosmopolitan, euryecious species was observed, with high abundance of pollution indicator Rotatoria species. Only few crustaceans were found. Zooplankton communities can be characterized by the occurrence of *Bdelloidea*, *Brachionus*, *Cephalodella*, *Euchlanis*, *Lecane* species. Biomass values were between 0.08 – 1.03 g/m³.

5. Lónyai csatorna

Occurrence of 48 Rotatoria and 2 Cladocera taxa was recorded. Among these species planktonic, metaphyton and benthic organisms were also found, but cosmopolitan, well adaptable species dominated the community. Biomass values varied between 0.01 – 1.01 g/m³, most probably due to the polluted character of the channel (frequently alpha-mesosaprobic, poly-alpha-mesosaprobic) and the presence of toxic materials. Also belonging to the more polluted stream category, among the Rotatoria organisms organic detritus feeders were represented in high proportion.

6. Bodrog

39 Rotatoria, 5 Cladocera and 1 Copepoda taxa were recorded, the fauna was dominated by planktonic organisms, the stream belongs to the cleaner, less polluted category. Seasonal changes are characteristic to the zooplankton community, in summer *Keratella cochlearis*, *K. cochlearis tecta*, *Filinia longiseta*, *Anuraeopsis fissa*, *Brachionus calyciflorus* and *B. quadridentatus* had large abundances. Zooplankton biomass changed between about 0.01 – 3.44 g/m³.

7. Hernád

Belongs to the streams characterized by higher water flow. On the upper stretch light and flow conditions are unfavorable to the growth of planktonic organisms ($0.01 - 0.02 \text{ g/m}^3$ biomass values), while towards the confluence flow velocity decreases followed by the consequent increase in abundance values, biomass values between $0.01 - 0.38 \text{ g/m}^3$. Apart from planktonic organisms (*Brachionus*, *Cephalodella*, *Keratella*, *Trichocerca* spp) benthic organisms from the sediment surface (*Conochilus*, *Encentrum*, *Rotaria* spp) occurred in the water body.

8. Bódva

Amongst the species, planktonic, metaphyton and characteristic benthic organisms were found. During the investigated time interval 60 Rotatoria, 2 Cladocera and 1 Copepoda taxa have occurred. In spring low biomass values were characteristic, while by late summer, especially at lower river stretches some Rotatoria species (e.g., *Keratella cochlearis*, *K. cochlearis tecta*, *Brachionus angularis*, *Anuraeopsis fissa*, *Pompholyx complanata*) were identified in large numbers (13.3 g/m^3 biomass). These values are already indicating values near to the eutrophic lakes.

9. Hangony

Zooplankton fauna of the creek is poor both in quantitative and qualitative terms. Most of the 22 Rotatoria and 1 Cladocera taxa belonged to planktonic elements. Biomass values were low during the vegetation period, with values of $0.01 - 0.24 \text{ g/m}^3$.

10. Jósza

As a result of high flow velocities, the abundance of the zooplankton community was found to be small throughout the overall investigation period. Species composition is poor, only 8 Rotatoria and 1 Crustacea taxa occurred. These were cosmopolitan species. Quantitative biomass values indicate low trophic state (max. biomass 0.01 g/m^3).

11. Sajó

Significant improvement in water quality can be observed at the border section of the river compared to previous years. Large quantity of pollutants reach the river in the vicinity of Miskolc. The water is rich in organic matter and zooplankton biomass (max. 9.88 g/m^3) is high, dominated by *Brachionus*, *Keratella Bdelloidea* and *Rotatoria* species. Near to the confluence, the natural regeneration can be observed, in many instances variable composition in zooplankton community is registered. During the investigated time period 81 Rotatoria, 4 Cladocera and 1 Copepoda taxa occurred. Most of the new Rotatoria species for Hungary were found in this river.

12. Eger-patak

Species number of Rotatoria is medium (59 taxon), while the Crustacea fauna is poor both from qualitative and quantitative point of view. The creek is rich in organic nutrients, frequently heavily polluted. Zooplankton biomass was therefore small or medium ($0.01 - 1.39 \text{ g/m}^3$). Beside the

dominance of several Rotatoria species the proportion of Ciliata and Zoogloea was also high indicating organic pollution.

13. Tarna

Organic nutrient contents is medium, occasionally the river is polluted. Species composition is relatively poor, having 38 Rotatoria and 1 Cladocera taxa. Zooplankton is dominated by the pollution tolerant species (*Brachionus angularis*, *Cephalodella gibba*, *Euchlanis dilatata*, *Keratella cochlearis*, *K. quadrata*, *Rotaria* spp) and some rare species also occur (*Brachionus bennini*, *B. plicatilis*, *Hexarthra fennica*, *Platyas quadricornis*). Biomass values varied within one vegetation period between 0.01–2.34 g/m³.

14. Zagyva

The river receives industrial and communal wastewater from many settlements, and also wastewater of sugar- factories. As a result of these, the species composition of zooplankton community is not really rich. With regards to abundance values Rotatoria species occurred in larger proportion (*Brachionus angularis*, *B. budapestinensis*, *Cephalodella* spp, *Colurella adriatica*, *Euchlanis dilatata*, *Filinia longiseta*, *Lecane* spp, *Rotaria* spp, *Synchaeta* spp). The occurrence of *Alona rectangula*, *Bosmina longirostris*, *Chydorus sphaericus*, *Daphnia pulex*, *D. magna*, *Peracantha truncata* is worth noticing. Biomass values changed 0.01 – 4.51 g/m³.

15. Hortobágy

Species composition of zooplankton community is characteristic to slow flowing waters. Apart from the plankton elements, ratio of the organisms living on macrophyte vegetation was high (*Cephalodella*, *Colurella*, *Dicranophorus*, *Epiphanes*, *Lepadella*, *Lophocharis*, *Mytilina*, *Platyas*, *Synchaeta*, *Trichocerca* spp), within the Cladocera the metaphyton species (*Iliocyrtus agilis*, *Kurzia latissima*, *Scapholeberis mucronata*, *Simocephalus exspinosus*) were characteristic. Qualitative composition of the communities and abundance values both indicate moderately polluted, eutrophic water quality.

16. Hortobágy-Berettyó

Water quality and species composition is similar to the Hortobágy river, occasionally having larger species number and biomass values (0.14 – 2.47 mg/m³).

17. Kösely

One of the most polluted streams of the region. Rotatoria species dominated, but mass production of ciliates was also observed. Zooplankton biomass is medium to high, (0.21 – 5.67 g/m³), dominated by organic detritus feeders.

18. Berettyó

Species rich community, variable species composition of zooplankton community is characteristic that is indicated by the occurrence of 89 Rotatoria and 6 Cladocera taxa. Most

of the rare species was found here (e.g. *Cephalodella biungulata*, *C. obvia*, *Encentrum oculatum*, *E. orthodactylum*, *Dicranophorus epipharis*, *Taphrocampa selenura*, *Trichotria curta*). Abundance and biomass values indicate the presence of small to medium zooplankton community. Many organisms indicate eutrophic and medium polluted water. Biomass varied between 0.03 – 0.92 g/m³.

19. Sebes-Körös

Abundance of zooplankton community is medium, biomass values are 0.01-1.57 g/m³. The richest fauna among the Tisza tributaries was found here, characterized by the occurrence of 96 Rotatoria, 10 Cladocera and 1 Copepoda taxa, presence of rare species was also high compared to other streams. Besides planktonic elements, significant amount of metaphyton organisms was also found. In smaller proportion sediment dwelling species also occurred. Water quality of the river is generally acceptable, with occasional more polluted states.

20. Fekete-Körös

Zooplankton abundance was medium, biomass values were between 0.05-2.19 g/m³. Amongst the 68 Rotatoria and 6 Cladocera species planktonic, bottom dwelling, littoral and macrophyte vegetation inhabiting species can be found. Water quality of the river was mesotrophic, occasionally meso-eutrophic moderately polluted.

21. Fehér-Körös

The plankton community of this particular stream was, both qualitatively and quantitatively, similar to the previous one. Biomass varied between 0.03 – 4.84 g/m³. Large values are due to *Synchaeta kitina*, *Polyarthra dolichoptera*, *P. vulgaris* and some *Brachionus* species.

22. Kettős-Körös

The zooplankton community of the river is variable, richer than those of the previous two Körös-stretch, indicated by the occurrence of 73 Rotatoria, 10 Cladocera and 1 Copepoda taxa. Abundance values of plankton communities indicate eutrophic conditions in summer (max. biomass 7.86 g/m³) in spite of this, the water of the river is only moderately polluted.

23. Hármás-Körös

At the upper river stretch the abundance is higher, biomass values are much greater here than near the confluence. At Gyoma, maximum biomass was 8.61 g/m³, while at Magyartés only 0.45/m³. Composition of the zooplankton is variable; 70 Rotatoria, 11 Cladocera and 1 Copepoda taxa have occurred in the investigated period. Organisms of different habitat types occurred in similar proportions as at the other Körös-stretches.

24. Maros

Among the Tisza tributaries the Maros is one of the most polluted one. Its fauna is characterized by cosmopolitan, adaptable, planktonic Rotatoria species. Both its Rotatoria and

Crustacea faunas are poor. Only 42 Rotatoria and 1 Cladocera species were found during the investigations. Zooplankton biomass varied greatly. During the spring floods it was low, that was followed by an enormous mass production in summer period. In the overall sampling period here, at the Maros, was the highest biomass measured, 74.71 g/m^3 on the whole watershed, indicating polytrophic condition. Water quality of this particular river is largely influencing the Tisza zooplankton communities both from qualitative and quantitative point of view.

25. Main Eastern Canal

The species composition of zooplankton community of the canal is rich, indicated by the occurrence of 81 Rotatoria, 9 Cladocera and 1 Copepoda taxa. In most of the year the community is dominated by planktonic species. Moderately polluted conditions in summer are characterized by pollution tolerant, eutrophic species (*Anuraeopsis fissa*, *Brachionus angularis*, *B. budapestinensis*, *Epiphanes macruroides*, *Filinia longiseta*, *Synchaeta tremula*, *Trichocerca pusilla*, *Polyarthra* spp). In winter-spring low trophity water indicating species are more frequently encountered. Biomass varies in the range of $0.01 - 2.30 \text{ g/m}^3$.

26. Main Western Canal

The species composition of the zooplankton community of this canal is somewhat poorer, as indicated by 50 Rotatoria and 3 Cladocera taxa. Abundance values and seasonal changes of abundance were similar to the Main Eastern Canal. Biomass was in the same magnitude of order, varied between $0.01 - 0.48 \text{ g/m}^3$.

27. Main Nagykunság Canal

Water quality of the Nagykunsági Main Canal is determined by the effluent from the Kisköre reservoir. Species composition of zooplankton communities is poor. 30 Rotatoria, 11 Cladocera and 1 Copepoda species were registered during the investigations. The plankton indicated in most of the year poor and moderate nutrient supply conditions, similar to non-polluted stagnant or slow flowing waters. It is eutrophic in summer months.

Most frequent Rotatoria species were: *Hexarthra mira*, *Synchaeta tremula*, *Notholca squamula*, *Pompholyx complanata* and *Polyarthra* spp. From early summer on high number of Cladocera species was characteristic, and the nauplius and copepodite larvae of Copepoda (biomass in July of 1992 was 6.10 g/m^3). Zooplankton biomass varied between $0.03 - 13.96 \text{ g/m}^3$.

28. Rába

The upper Hungarian stretch of this river has high flow velocities, abundance of zooplankton community is therefore low. The abundance values are increasing downstream, indicating ongoing eutrophication processes. 64 Rotatoria, 12 Cladocera and 6 Copepoda species were recorded at the Hungarian river section, biomass values varied between $0.02 - 1.06 \text{ g/m}^3$. Dominant species were *Brachionus* spp, *Euchlanis dilatata*, *Keratella cochlearis*, *K. quadrata*, *Trichocerca* spp, *Bosmina longirostris*, *Chydorus sphaericus*, *Moina micrura*, *Acanthocyclops robustus*, *Mesocyclops leuckarti*, indicating medium and slow flow velocities, with moderate nutrient contents.

29. Répce

Species composition of zooplankton community is poor with low abundance. Only 32 Rotatoria, 7 Cladocera and 3 Copepoda species were found, these are quite common in Hungarian waters. Biomass values were in the range of $0.07 - 0.23 \text{ g/m}^3$. High flow velocities are unfavorable for the formation of larger zooplankton populations.

30. Rábca

37 Rotatoria, 9 Cladocera and 3 Copepoda taxa were found in this river. In all cases samples were dominated by Rotatoria. Biomass value is similar to Répce, varied between $0.06 - 1.12 \text{ g/m}^3$. Some rare rotifers (*Beauchampiella eudactylota*, *Euchlanis oropha*, *Lecane ichthyura*, *Lecane stenroosi*) were also recorded here.

31. Marcal

The composition and abundance of the zooplankton community of the upper and lower stretch of the river showed marked differences. Altogether 37 Rotatoria 8 Cladocera and 2 Copepoda species were found. As a result of the benthic eutrophication in the upper stretch, the biomass is small ($0.02 - 0.38 \text{ g/m}^3$), indicating good water quality. Many rare species were recorded here (*Cephalodella ventripes*, *Euchlanis parva*, *Lecane hamata*, *Mytilina ventralis brevispina*), which are living in macrophyte vegetation.

Near to the confluence, biomass increased ($0.06 - 8.93 \text{ g/m}^3$), indicating increasing eutrophication. High numbers were due to eutrophic rotifers.

32. Lajta

31 Rotatoria, 3 Cladocera and 1 Copepoda species were found at the Mosonmagyaróvár sampling site of the fast flowing river. Species composition and biomass value of the zooplankton community indicate good water quality. As a result of hydraulic conditions no large populations were formed (biomass varied between $0.09 - 0.92 \text{ g/m}^3$). Some rare Rotatoria species were also recorded here: *Dicranopohorus epipharis*, *Epiphanes pelagica*, *Itura aurita*, *Paradicranopohorus hudsoni*.

33. Concó

The water of the creek is very rich in organic matter. Most of Rotatoria and Crustacea taxa are characteristic to polluted and highly trophic waters. Most of the populations inhabit the surface of the sediment and macrophyte vegetation. Species composition is poor, only 24 Rotatoria, 5 Cladocera and 6 Copepoda species were found. Large biomass values ($0.41 - 11.69 \text{ g/m}^3$; average 3.21 g/m^3) are supporting the above argumentation.

34. Általér

This stream was practically divided into three section by water management activities. Zooplankton of the stretch upstream of the cooling lakes is characterized by only 29 Rotatoria, 4 Cladocera and 3 Copepoda species. The biomass is generally small, but as a result of extreme

weather conditions one species was able to establish large populations (e.g. *Bosmina coregoni* 2.90 g/m³, *Brachionus* spp. and *Notholca acuminata* 1.42 g/m³).

The second stretch is in between the cooling lakes of the power stations and the Tatai Öreg-Lake, it has more stable water regime, and is richer in species (35 Rotatoria, 12 Cladocera 5 Copepoda). Biomass varied between 0.04 – 14.32 g/m³. In the fall of 1993 and the spring of 1994, for example large populations were formed almost entirely of *Bosmina coregoni*, *Daphnia longispina*, and larvae of copepods. The communities were formed by taxa characteristic to eutrophic waters.

In the water of the third section, downstream of the Tatai Öreg-Lake, zooplankton communities characteristic to fishponds were found, dominated by species typically occurring in eutrophic and polytrophic stagnant waters. Accordingly, biomass values varied between 9.73 – 110.05 g/m³ in almost every season.

35. Séd-Nádor-catorna

Sampling was carried out downstream of Székesfehérvár. The communities were characterized by dominant Rotatoria and Crustacea species living in eutrophic and polytrophic waters. Almost all of the 48 Rotatoria, 9 Cladocera and 5 Copepoda species found are indicators of waters rich in organic matter and plant nutrients. Biomass was gradually increasing downstream and varied in the range of 0.12 – 13.61 g/m³. Among the investigated streams water quality of this canal is one of the worst.

36. Sió

Sampling on the Sió was undertaken when no water outflow from Lake Balaton was conducted. On the basis of the zooplankton community investigations the stream can be divided into two sections. In the Siófok region communities are richer, indicated by the occurrence of 54 Rotatoria, 10 Cladocera and 4 Copepoda species. Biomass at this section in general was low (0.12 – 0.91 g/m³). In warm summer period however, when no water flow is encountered, a few eutrophic species of *Brachionus*, *Euchlanis*, *Keratella* and *Lecane* formed large populations (max. biomass value was 5.18 g/m³).

Downstream the composition of the community showed species number decrease and abundance increase. Dominance of taxa characteristic to nutrient rich waters is evident in almost every season. Biomass varied between 0.79 – 10.67 g/m³, but during the vegetation period its value was near to maximum. On the basis of its zooplankton community the Sió belongs to the eutrophic category.

37. Kapos

55 Rotatoria, 14 Cladocera and 2 Copepoda species were found in the river. Species composition of zooplankton community until Dombóvár is relatively poor, due to the high amounts of filamentous algae and macrovegetation in the river bed and in the littoral zone. As a result of benthic eutrophication the biomass is low (0.04 - 1.23 g/m³). For this particular river section the occurrence of non-planktonic species is characteristic: *Colurella colurus*, *Euchlanis pyriiformis*, *Lecane closterocerca*, *Lepadella patella*, *Lophocharis oxysternon*, *Mytilina ventralis*, *Alona* spp, *Macrothrix laticornis*, *Eucyclops serrulatus*.

At river sections upstream of Dombóvár the species composition changed, as indicated by

the dominance of eutrophic taxa: *Brachionus*, *Euchlanis*, *Keratella*, *Polyarthra* spp, *Bosmina longirostris*, *Chydorus sphaericus*, *Daphnia hyalina*, *Daphnia longispina*, *Diaphanosoma brachyurum*, *Moina micrura*. As a result of the polluted character of the river, in spite of the nutrient supply no biomass increase can be observed downstream, biomass varied between 0.11 – 2.28 g/m³.

38. Dráva

On the Hungarian river section 43 Rotatoria, 5 Cladocera and 4 Copepoda species were found. Larger abundances were not found in any sampling sites probably because of low flow velocities. Especially the number of planktonic microcrustaceans was low. Accordingly, the biomass values varied between 0.03 – 0.69 g/m³. Some rare rotatorian species occurred, such as *Keratella americana*, *K. tropica*, *Lecane ichthyoura*, *Lophocharis salpina*, *Tetramastix opoliensis*. Neither the species composition, nor the abundance values changed along the longitudinal section of the river.

39. Mura

At Letenye we were only able to record 24 Rotatoria, 1 Cladocera and 1 Copepoda taxa. Frequently occurring rotifer species were *Brachionus calyciflorus*, *B. quadridentatus*, *Euchlanis dilatata*, *Filinia longiseta*, *Keratella cochlearis*, *Lecane bulla*, *Polyarthra vulgaris*. Biomass value was extremely low in the range of 0.04 – 0.93 g/m³.

40. Rinya

Species composition of zooplankton community of this river was poor, indicated by the occurrence of 17 Rotatoria, 1 Cladocera and 1 Copepoda taxa. Some eutrophic Rotatoria species formed large populations occasionally (*Brachionus angularis*, *B. quadridentatus*, *Keratella cochlearis*, *K. cochlearis micracantha*, *Polyarthra vulgaris*). Because of their small body weight however, this biomass was not great (max. 1.11 g/m³).

41. Kerka

25 Rotatoria, and 4 Cladocera species were only recorded from the samples. Both the abundance and biomass values were low, the latter varied between 0.09 – 0.88 g/m³. Beside the eutrophic planktonic Rotatoria species a few macrophyte dwelling ones also occurred (*Cephalodella forficula*, *Encentrum plicatilis*, *Lecane hamata*, *Trichocerca elegans*), indicating good water quality.

42. Zala

The river can be divided into three section on the basis of the species composition of its zooplankton communities. At the section upstream of Zalaegerszeg in the clean water we identified 27 Rotatoria, 4 Cladocera and 3 Copepoda species. Their biomass varied between 0.09 – 1.19 g/m³. Of the Rotatoria species the *Cephalodella sterea*, *Keratella testudo*, *Mytilina acanthophora* and *Trichocerca tigris* is considered to be rare in Hungary. Among the Crustacea

planktonic, and littoral species were also found (e.g. *Alona rectangularis*, *Chydorus sphaericus*, *Disparalona rostrata*, *Macrocyclus fuscus*).

Due to the effect of the wastewaters of Zalaegerszeg the species composition of the zooplankton community is becoming poorer. Especially the species number of the Rotatoria is reduced, the number of the microcrustaceans practically did not change. Up to the Kis-Balaton Reservoir (Zalaapáti) neither the abundance values, nor the biomass showed significant increase. Biomass varied between 0.13 – 0.38 g/m³ that is considered to be very low value on this particular river section.

Since the operation of the II. Phase of the Kis-Balaton Reservoir water characteristic to bogs flows at the confluence (Fenékpuszt), and therefore one cannot speak of planktonic communities of flowing water in this section. Species composition and abundance of the community is determined by the outflow water of the reservoirs. A rich community was found, as indicated by the occurrence of 35 Rotatoria, 10 Cladocera and 5 Copepoda taxa. The bog water provides poor food for filter feeding Rotatoria and microcrustacean species, therefore large populations were not formed, biomass was only between 0.44 – 1.71 g/m³.

43. Mosoni-Danube

Altogether 87 taxa were found in the samples of the Mosoni-Danube, rotifers occurred in greatest species number (50) and abundance, while Cladocera and Copepoda were represented by 26 species. In spite of the species richness there were only a small number of rare species present in the samples. Species composition of the community showed a gradual increase and dominance of taxa characteristic to nutrient rich waters become evident downwards. Effect of the wastewaters of Mosonmagyaróvár and Győr can be traced by the increase of abundance and biomass. At these sampling locations species characteristic to eutrophic and polytrophic waters dominated in all cases, especially the rotatorian *Brachionus*, *Keratella* spp. and the cladoceran *Bosmina longirostris*, *Moina micrura* and larvae of Copepoda.

Based on zooplankton communities the Mosoni-Danube can therefore be divided into two sections. Upstream of Győr rich species composition was found, while downstream of the city increasing abundance indicated eutrophic conditions and significant deterioration of water quality.

Summary

Identification of the Rotatoria fauna and other planktonic zooplankton species of the River Tisza and its tributaries, and of the Transdanubian watercourses revealed that the zooplankton community of the watershed is largely build-up by cosmopolitan, well-adaptable species of high ecological tolerance. In the Tisza River and in its major tributaries mostly planktonic species were the dominant ones, while in smaller creeks and streams metaphyton and benthic elements are also frequently added to this species spectrum. Species richness of the Cladocera fauna only occurs in slower streams. The Copepoda fauna was characterized by the occurrence of juvenile forms, the number of adult individuals was low.

During the three years 19 Rotatoria taxa new to the Hungarian fauna and several rare species (59 Rotatoria and 7 Cladocera) were recorded.

On the basis of the quantitative and qualitative zooplankton investigation the watercourses are grouped into the following categories:

- poor fauna, generally fast flowing: Hangony, Jósza, Mura, Répce, Kerka, Rinya, Dráva, Lajta;
- medium rich fauna, fast and medium velocity: Bodrog, Bódva, Hernád, Rábca, Rába, Zala (upper stretch);
- mesotrophic state, medium velocity: Tisza (upper stretch), Sajó, Túr, Sebes-Körös, Fekete-Körös, Fehér-Körös, Main Eastern Canal, Main Western Canal, Marcal, Zala (middle stretch);
- eutrophic-polytrophic state, slow-flowing: Tisza (middle and lower reach), Hortobágy, Hortobágy-Berettyó, Berettyó, Kettős-Körös, Hármaskörös, Main Nagykunság: Canal, Zagyva (middle and lower reach), Sió, Általér (middle and lower stretch);
- moderately and heavily polluted with organic pollutants: Szamos, Kraszna, Lónyai-csatorna, Eger-patak, Kösely, Zagyva, Tarna, Maros, Concó, Séd-Nádor Canal, Kapos (middle and lower stretch), Mosoni-Duna (lower stretch).

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Appendix

Rotatoria fauna of Tisza River and tributaries

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ROTATORIA																											
Anuraeopsis fissa (Gosse)	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ascomorpha ecaudis (Perty)							•																				
Asplanchna brightwelli (Gosse)	•																										
A. priodonta (Gosse)	•	•			•		•	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
A. sieboldi (Leydig)	•																										
Beauchampiella eudactylota (Gosse)																										•	
Brachionus angularis Gosse	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. bennini (Leissling)	•	•	•									•	•	•	•	•	•					•	•	•	•	•	•
B. bidentata Anderson					•	•															•						
B. budapestinensis Daday	•	•	•	•	•	•						•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. calyciflorus amphiceros Ehrb.	•	•	•	•	•	•						•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. c. anuraeiformis (Brehm)	•	•	•	•	•	•						•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. c. calyciflorus (Pallas)	•	•	•	•	•	•	•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. c. dorcas (Gosse)	•					•	•	•			•		•		•		•	•						•			
B. c. spinosus (Wierzejski)	•								•								•	•	•	•	•	•	•	•	•	•	•
B. diversicornis (Daday)	•	•												•			•								•		
B. falcatus Zacharias	•																			•	•						
B. leydigi tridentatus (Sernov)	•					•	•	•				•	•	•													•
B. nilsoni Ahlstrom		•	•					•				•					•			•							
B. plicatilis O.F.Müller													•			•											
B. rubens Ehrb.	•				•	•													•	•						•	
B. urceolaris O.F.Müller	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
B. quadridentatus (Hermann)	•	•	•	•	•									•	•	•	•	•	•	•			•	•			
B. q. ancylognatus (Schmarda)	•	•	•	•	•															•							
B. q. brevispinus (Ehrb.)	•	•	•	•	•							•	•		•	•	•	•	•	•	•	•	•	•	•	•	•
B. q. cluniorbicularis (Skorikov)	•	•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	•	•			•	•	
B. q. melheni (Barrois et Daday)	•												•				•	•						•	•		

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
B. q. rhenanus (Lauterborn)	•	•		•	•		•				•	•		•	•			•	•						•		
Brachionus sp.																										•	
Cephalodella auriculata O.F.Müller	•	•																									
C. biungulata Wulfert	•	•	•	•	•		•	•			•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
C. catellina O.F.Müller	•		•	•	•			•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
C. forficula (Ehrb.)	•	•		•			•	•	•			•	•			•		•	•		•		•				•
C. gibba (Ehrb.)	•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•
C. giganthea Remane																		•									
C. globata (Gosse)															•												
C. gobio (Wulfert)	•				•																						
C. gracilis (Ehrb.)			•																	•							
C. limosa (Wulfert)	•							•												•							
C. megaloccephala (Glascott)	•	•	•	•							•									•	•						
C. misgurnus (Wulfert)	•		•	•	•	•		•			•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•
C. mucronata (Myers)	•																		•								
C. obvia (Donner)																		•				•					
C. remanei (Wiszniewski)					•																			•		•	
C. sterea sterea (Gosse)	•	•	•	•	•		•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
C. s. dentata (Donner)								•			•																
C. s. minor (Donner)											•																
C. s. mutata (Donner)								•																			
C. stenroosi (Wulfert)				•				•																			
C. tenuiseta (Donner)	•																										
C. tinca (Wulfert)				•							•																
C. ventripes (Dixon-Nuttal)	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
C. v. angustior (Donner)	•																									•	•
Cephalodella sp.	•	•	•	•	•			•	•				•		•	•	•	•	•	•	•	•	•	•	•	•	•
Collotheca sp.																	•		•		•				•		
Colurella adriatica Ehrb.	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
C. colurus Ehrb.	•		•	•				•	•		•	•	•	•	•	•	•	•	•			•					
C. gastracantha Hauer								•																			
C. obtusa (Gosse)	•		•	•							•					•	•	•	•	•	•	•					
C. uncinata O.F.Müller	•	•	•	•			•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Conochilus dossuarius Hudson																							•				
C. unicornis Rousselet	•							•									•	•									
Conochilus sp.																										•	
Dicranophorus caudatus Ehrb.				•							•	•	•				•	•	•								
D. epicharis (Harring et Myers)																		•									
D. forcipatus (O.F.Müller)															•	•		•								•	
D. grandis (Ehrb.)			•		•														•	•	•	•					
D. robustus (Harring et Myers)																		•									
D. uncinatus (Milne)	•	•		•	•		•				•	•			•	•	•	•	•			•	•	•	•	•	•
Dipleuchlanis propatula (Gosse)																			•								

TAXA

Sampling sites

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<i>Dissotrocha aculeata</i> (Ehrb.)	.																										
<i>Encentrum diglandula</i> (Zawadowski)																		.				.					
<i>E. eurycephalum</i> (Wulfert)	.					.	.	.	.	.																	
<i>E. glaucum</i> (Wulfert)								.																			
<i>E. grande</i> (Western)	.									.																	
<i>E. incisum</i> (Wulfert)								.																			
<i>E. martes</i> (Wulfert)						.	.	.																			
<i>E. mustela</i> (Milne)	.					.						.						.									
<i>E. oculatum</i> (Harring et Myers)																		.									
<i>E. orthodactylum</i> (Wulfert)	.	.								.								.	.							.	
<i>E. plicatum</i> (Eyfert)																		.									
<i>E. putorius</i> (Wulfert)	.																										
<i>E. p. armatum</i> Donner							.																				
<i>E. saundersiae</i> (Hudson)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>E. wiszniewski</i> (Wulfert)						.																					
<i>Encentrum</i> sp.	.	.	.	.						.					.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epiphanes brachionus</i> (Ehrb.)				.																						.	
<i>E. macrourus</i> (Barrois et Daday)	.	.		.											.	.	.	.	.	.	.	.	.	.	.	.	.
<i>E. senta</i> (O.F.Müller)				.														.									
<i>Euchlanis dilatata</i> Ehrb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>E. oropha</i> Gosse									.					.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Filinia cornuta</i> (Weisse)			.														.										
<i>F. c. brachiata</i> (Rousselet)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>F. c. monoarthra</i> (Sokolova)	.																						.				
<i>F. longiseta</i> (Ehrb.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>F. minuta</i> (Smirnow)	.																										
<i>F. terminalis</i> (Plate)	.																							.	.	.	.
<i>Gastropus</i> sp.																	.										
<i>Hexarthra fennica</i> (Levander)												.				.											
<i>H. mira</i> (Hudson)	.	.													.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Itura aurita</i> (Ehrb.)			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>I. myersi</i> Wulfert				.								.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>I. viridis</i> (Stenroos)	.										.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Itura</i> sp.																		.									
<i>Kellicottia longispina</i> Kellicott	.																										
<i>Keratella cochlearis</i> (Gosse)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>K. c. macracantha</i> (Lauterborn)	.	.				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>K. c. micracantha</i> (Lauterborn)	.	.				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>K. c. tecta</i> (Gosse)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>K. irregularis connectens</i> (Lauterborn)						.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>K. testudo</i> (Ehrb.)	.										.				.										.		
<i>K. t. irregularis</i> (Jakubski)												.			.				.								
<i>K. tropica</i> Apstein	.	.																		.	.	.	.	.	.	.	.

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<i>K. t. reducta</i> Fadeev	•	•	•	•								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>K. quadrata</i> (O.F.Müller)	•					•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>K. valga</i> (Ehrb.)	•																										
<i>K. v. monospina</i> (Klausener)	•																										
<i>Lecane aculeata arcula</i> (Harring)	•										•					•											
<i>L. arcuata</i> (Bryce)	•																				•						
<i>L. aspasia</i> Myers												•					•										
<i>L. bulla</i> (Gosse)	•	•				•					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. clostrocerca</i> (Schmarda)	•	•	•	•	•		•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. elongata</i> Harring et Myers											•																
<i>L. flexilis</i> (Gosse)	•																								•		
<i>L. hamata</i> Stokes	•	•	•	•	•						•	•			•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. inopinata</i> Harring et Myers								•			•																
<i>L. ludwigi</i> (Eckstein)	•																										
<i>L. luna</i> (O.F.Müller)	•						•				•	•			•		•	•	•	•	•	•	•	•	•	•	•
<i>L. l. presumpta</i> Ahlstrom	•		•	•																•							
<i>L. lunaris</i> (Ehrb.)	•	•	•				•							•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. nana</i> (Murray)						•																			•		
<i>L. ohioensis</i> (Herrick)																•									•		
<i>L. o. appendiculata</i> (Levander)																		•									
<i>L. quadridentata</i> (Ehrb.)	•										•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. tenuiseta</i> Harring											•								•		•						
<i>L. unguolata</i> (Gosse)																									•		
<i>Lecane</i> sp.	•										•												•		•		
<i>Lepadella acuminata</i> (Ehrb.)	•				•											•	•	•	•	•	•	•	•	•	•	•	•
<i>L. ovalis</i> (O.F.Müller)														•	•	•			•	•							
<i>L. patella</i> (O.F.Müller)	•	•	•	•	•			•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>L. p. oblonga</i> (Ehrb.)																			•	•							
<i>L. quadricarinata</i> (Stenroos)														•					•								
<i>L. rhomboides</i> (Gosse)				•										•													
<i>Lindia torulosa</i> Dujardin					•						•							•									
<i>Lophocharis oxysternon</i> (Gosse)					•						•	•	•	•	•	•	•	•									
<i>L. salpina</i> (Ehrb.)														•	•	•											
<i>Metadiaschiza trigona</i> Rousselet	•		•																•								
<i>Mniobia tetraodon</i> Ehrb.	•																										
<i>Monommata aequalis</i> (Ehrb.)														•													
<i>M. longiseta</i> (O.F.Müller)																•	•	•	•	•	•	•	•	•	•	•	•
<i>M. grandis</i> Tessin		•																		•							
<i>Monommata</i> sp.	•																										
<i>Mytilina compressa</i> (Gosse)																	•	•									
<i>M. crassipes</i> (Lucks)			•														•										
<i>M. mucronata</i> (O.F.Müller)	•										•			•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>M. ventralis</i> (Ehrb.)					•									•	•	•		•		•		•		•	•	•	•

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<i>M. v. brevispina</i> (Ehrb.)	•				•							•			•		•		•		•	•	•		•		
<i>M. v. macracantha</i> (Gosse)	•																•		•	•		•	•		•	•	
<i>Notholca acuminata</i> (Ehrb.)	•			•			•	•			•	•	•													•	
<i>N. labis</i> Gosse	•																									•	
<i>N. squamula</i> (O.F.Müller)	•					•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•		•	•	•
<i>Notommata cyrtopus</i> Gosse												•				•											
<i>N. pseudocerberus</i> Beauchamp																					•						
<i>Notommata</i> sp.	•														•		•		•								
<i>Paradicranophorus hudsoni</i> (Glascott)								•					•				•		•		•						
<i>P. sudzuki</i> Donner								•																			
<i>Philodina megalotrocha</i> Ehrb.														•													
<i>Platylabus patulus</i> (O.F.Müller)																	•		•	•	•	•	•	•		•	
<i>P. quadricornis</i> (Ehrb.)					•									•	•	•	•									•	
<i>Pleurotrocha petromyzon</i> Ehrb.														•				•									
<i>Polyarthra dolichoptera</i> (Idelson)	•	•	•	•	•	•	•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>P. euryptera</i> (Wierzejski)																			•		•		•			•	
<i>P. longiremis</i> Carlin																		•	•			•					
<i>P. major</i> (Bruckhardt)	•							•									•					•	•				•
<i>P. remata</i> (Skorikov)	•		•	•													•				•				•		•
<i>P. vulgaris</i> Carlin	•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Polyarthra</i> sp.	•																•										
<i>Pompholyx sulcata</i> Hudson	•	•				•		•			•	•		•		•			•				•		•	•	•
<i>Postclausa hyptopus</i> (Ehrb.)																			•								
<i>Proales doliaris</i> (Rousselet)	•	•																									
<i>P. theodora</i> (Gosse)		•	•					•	•	•		•							•				•			•	•
<i>Proales</i> sp.	•							•											•	•				•		•	
<i>Proalides tentaculatus</i> Beauchamp	•																						•			•	
<i>Pseudoharringia similis</i> Fadeev												•			•												
<i>Ptygura melicerta</i> (Ehrb.)																		•		•							
<i>Ptygura</i> sp.				•															•								
<i>Rhinoglena frontalis</i> (Ehrb.)		•																		•							
<i>Rotaria citrina</i> (Ehrb.)																						•					
<i>R. neptunia</i> (Ehrb.)	•	•		•								•	•		•	•	•	•	•					•	•		•
<i>R. rotatoria</i> (Pallas)	•						•	•	•			•											•				
<i>R. socialis</i> (Kellicott)							•	•		•		•	•		•												
<i>R. tridens</i> Montet																					•						
<i>Rotaria</i> sp.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Scardium longicaudum</i> (O.F.Müller)		•														•	•			•	•	•	•	•		•	
<i>Sinanthrerina socialis</i> (Linné)	•				•															•	•	•	•	•			
<i>Squatinella mutica</i> (Ehrb.)															•												
<i>S. rostrum</i> (Schmarda)																		•	•	•	•				•		
<i>Synchaeta grandis</i> Zacharias	•																										
<i>S. kitina</i> Rousselet	•																		•		•	•	•	•		•	•

TAXA

Sampling sites

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<i>S. longipes</i> Gosse	.					.														.	.	.	.	.	.		
<i>S. oblonga</i> Ehrb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. pectinata</i> Ehrb.	.	.				.					.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. stylata</i> Wierzejski	.											.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. tremula</i> (O.F.Müller)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Synchaeta</i> sp.	.	.		.	.							.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Taphrocampa annulosa</i> Gosse																		.	.	.	.	.	.	.	.	.	.
<i>T. selenura</i> Gosse																		.	.				.	.	.	.	.
<i>Testudinella patina</i> (Hermann)	.			.	.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. p. intermedia</i> Anderson											.																.
<i>T. p. trilobata</i> Anderson et Shepard																						.					.
<i>T. truncata</i> (Gosse)	.										.			.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Trichocerca agnata</i> Wulfert																			.								.
<i>T. bicristata</i> (Gosse)																										.	.
<i>T. birostris</i> (Minkiewicz)																			.								.
<i>T. brachyura</i> (Gosse)								.			.																.
<i>T. dixon-nuttali</i> (Jennings)	.										.												.				.
<i>T. elongata</i> (Gosse)												.					.	.	.	.	.	.	.	.	.	.	.
<i>T. myersi</i> (Hauer)											.			.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. porcellus</i> (Gosse)			.												.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. pusilla</i> (Lauterborn)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. rattus</i> (O.F.Müller)	.							.								.		.	.	.	.	.	.	.	.	.	.
<i>T. similis</i> (Wierzejski)	.						.	.									.	.	.	.	.	.	.	.	.	.	.
<i>T. tenuior</i> (Gosse)				.		.	.	.			.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. tigris</i> (O.F.Müller)	.											.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. uncinata</i> (Voigt)			.																								.
<i>T. weberi</i> Jennings	.			.		.		.									.						.				.
<i>Trichocerca</i> sp.	.	.	.	.	.										.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Trichotria curta</i> (Skorikov)	.	.	.					.			.							.					.				.
<i>T. pocillum</i> (O.F.Müller)	.				.						.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>T. tetractis</i> (Ehrb.)	.	.				.	.	.			.						.		.	.	.	.	.	.	.	.	.
Total species number:	128	57	59	59	48	39	44	60	22	8	81	59	38	59	67	78	78	89	96	68	64	73	70	42	81	50	30

Crustacea fauna of the Tisza River and tributaries

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
CLADOCERA																											
<i>Alona affinis</i> (Leydig)																											•
<i>A. costata</i> Sars			•													•					•			•			
<i>A. guttata</i> Sars														•	•	•	•	•	•	•	•					•	
<i>A. quadrangularis</i> (O.F.Müller)																											•
<i>A. rectangula</i> Sars			•											•				•	•			•	•	•			
<i>Alona</i> sp.												•			•												
<i>Bosmina longirostris</i> (O.F.Müller)	•				•	•		•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Camptocercus rectirostris</i> Schoedler																									•		
<i>Ceriodaphnia laticaudata</i> P.E.Müller	•																										
<i>C. reticulata</i> (Jurine)							•							•													
<i>Ceriodaphnia</i> sp.													•				•		•							•	
<i>Chydorus sphaericus</i> (O.F.Müller)	•				•	•						•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Daphnia cucullata</i> Sars	•																	•	•				•			•	
<i>D. c. berolinensis</i> Schoedler	•																										
<i>D. longispina</i> O.F.Müller	•																	•				•	•	•	•	•	
<i>D. magna</i> Straus															•												
<i>D. pulex</i> Leydig em.Scourfield															•												
<i>Daphnia</i> sp.							•	•																			•
<i>Diaphanosoma brachyurum</i> (Liévin)	•																		•	•		•				•	
<i>Graptoleberis testudinaria</i> (Fischer)																•		•				•					
<i>Iliocryptus agilis</i> Kurz	•				•	•					•			•													
<i>I. sordidus</i> (Liévin)												•															
<i>Kurzia latissima</i> (Kurz)															•			•									
<i>Macrothrix hirsuticornis</i> Norman et Brady																•											
<i>M. laticornis</i> (Jurine)	•	•					•				•															•	
<i>Moina micrura</i> Kurz	•		•												•						•	•	•		•	•	
<i>Moina</i> sp.	•													•						•			•				
<i>Oxyurella tenuicaudis</i> (Sars)														•	•				•								
<i>Peracantha truncata</i> (O.F.Müller)																			•				•				
<i>Pleuroxus aduncus</i> (Jurine)	•														•	•		•		•		•		•	•	•	
<i>P. trigonellus</i> (O.F.Müller)														•					•								
<i>Scapholeberis mucronata</i> (O.F.Müller)	•														•	•					•	•					
<i>Sida crystallina</i> (O.F.Müller)	•														•							•					
<i>Simocephalus exspinosus</i> (Koch)															•	•	•					•	•	•			
<i>S. vetulus</i> (O.F.Müller)			•																							•	
<i>Tretocephala ambigua</i> (Lilljeborg)																									•		
Total:	16	2	1	0	2	5	2	2	1	0	4	2	1	10	9	8	8	6	10	6	4	10	11	1	9	3	11

TAXA	Sampling sites																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
COPEPODA																											
Calanoida																											
Eudiaptomus gracilis (Sars)						•																					
Eudiaptomus sp.	•																								•		
Cyclopoida																											
Cyclops vicinus Ulianine	•			•										•		•	•										
Eucyclops macrurus (Sars)								•			•																
E. serrulatus (Fischer)										•		•				•			•			•					
Eucyclops sp.														•													
Megacyclops viridis (Jurine)	•																				•	•	•				•
Mesocyclops leuckarti (Claus)	•																					•					
Thermocyclops crassus (Fischer)	•																										
Juvenilis form	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Total:	6	1	1	2	1	2	1	2	1	2	2	2	1	2	1	2	2	1	2	1	1	2	2	1	2	1	2

Rotatoria fauna of Transdanubian streams

TAXA	Sampling sites																
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
ROTATORIA																	
Anuraeopsis fissa (Gosse)			*						*						*	*	
Ascomorpha ecaudis Perty			*	*			*		*	*					*	*	
A. saltans Bartsch		*															
Asplanchna brightwelli Gosse									*								
A. girodi de Guerne							*			*							
A. herricki de Guerne														*			
A. priodonta Gosse	*	*	*		*		*	*	*	*	*	*			*	*	
Bdelloidea sp.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Beauchampiella eudactylota (Gosse)				*											*		
Brachionus angularis Gosse	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
B. a. bidens (Plate)	*									*							
B. bidentata Anderson									*								
B. budapestinensis Daday	*	*			*		*	*	*	*	*				*	*	
B. calyciflorus calyciflorus Pallas	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	
B. c. amphicerus (Ehrb.)	*	*	*		*	*	*	*	*	*	*			*	*	*	
B. c. anuraeiformis (Brehm)	*						*	*	*	*	*			*	*	*	
B. c. dorcus (Gosse)	*		*		*	*	*	*	*	*	*	*			*		
B. c. spinosus (Wierzejski)			*				*	*			*				*		
B. diversicornis (Daday)	*						*	*	*	*	*			*	*	*	
B. falcatus Zacharias										*							
B. leydigi Cohn	*						*	*	*	*	*					*	
B. l. tridentatus (Sernov)	*	*	*	*	*		*	*	*	*	*	*				*	
B. nilsoni Ahlstrom	*																
B. plicatilis O.F.Müller								*									
B. quadridentatus quadridentatus Hermann	*		*	*		*	*	*		*						*	
B. q. ancylognathus (Schmarda)																*	
B. q. brevespinus (Ehrb.)	*	*		*	*	*		*	*	*	*	*	*	*	*	*	
B. q. cluniorbicularis (Skorikov)	*			*			*	*	*	*		*				*	
B. q. melheni (Barrois et Daday)			*	*						*	*					*	
B. q. rhenanus (Lauternborn)									*								
B. rubens Ehrb.					*	*		*		*							
B. urceolaris O.F.Müller	*	*	*		*	*	*	*	*	*	*	*	*		*	*	
Cephalodella catellina (O.F.Müller)	*	*															
C. forficata (Ehrb.)			*	*					*								
C. forficula (Ehrb.)	*													*			
C. gibba (Ehrb.)	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	
C. stenroosi Wulfert							*										
C. sterea (Gosse)											*				*		
C. ventripes (Dixon-Nuttall)	*	*		*	*				*			*					
Cephalodella sp.		*															
Collotheca ornata (Ehrb.)								*	*								

TAXA	Sampling sites																
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
Colurella adriatica Ehrb.																•	
C. colurus (Ehrb.)											•					•	
Dicranophorus epipharis Harring et Myers	•				•			•									
D. forcipatus (O.F.Müller)										•	•					•	
Dicranophorus. sp.										•							
Dipleuchlanis propatula (Gosse)	•																
Elosa sp																•	
Encentrum plicatum (Eyfert)															•		
E. saundersiae (Hudson)									•								
Encentrum. sp.												•					
Epiphanes pelagica (Jennings)	•				•												
E. senta (O.F.Müller)	•					•		•									
Euchlanis dilatata Ehrb.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
E. lyra Hudson	•																
E. oropha Gosse	•		•														
E. parva Rousselet					•												
E. pyriformis Gosse											•						
E. triquetra Ehrb.	•																
Filinia longiseta (Ehrb.)	•			•	•	•	•	•	•	•	•	•	•	•	•	•	
F. terminalis (Plate)	•				•					•	•			•	•	•	
Hexarthra fennica (Levander)								•									
H. mira (Hudson)											•						
Itura aurita (Ehrb.)	•				•	•											
Kellikottia longispina (Kellicott)				•						•		•			•	•	
Keratella americana Carlin												•					
K. cochlearis cochlearis (Gosse)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
K. c. micracantha (Lauterborn)	•						•		•		•			•	•		
K. c. tecta (Gosse)	•	•	•		•	•	•	•	•	•	•	•	•		•	•	
K. quadrata (O.F.Müller)	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	
K. q. frenzeli (Eckstein)	•									•							
K. testudo (Ehrb.)	•		•												•		
K. tropica (Apstein)	•		•					•	•	•	•	•				•	
K. valga (Ehrb.)					•			•	•	•	•					•	
Lecane bulla (Gosse)	•	•	•	•			•	•	•	•	•	•			•	•	
L. clostercerca (Schmarda)	•									•	•						
L. hamata Stokes					•					•					•		
L. ichthyoura Anderson et Shepard				•													
L. luna (O.F.Müller)	•	•	•	•		•		•	•	•	•				•		
L. lunaris (Ehrb.)					•	•		•		•	•	•				•	
L. quadridentata (Ehrb.)				•						•							
L. stenroosi (Meissner)	•		•														
L. unguolata (Gosse)					•					•	•						
Lepadella ovalis (O.F.Müller)	•									•						•	

TAXA

Sampling sites

	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
<i>L. patella</i> (O.F.Müller)	.			.				.	.	.	.	.			.	.
<i>L. triptera</i> (Ehrb.)						.										
<i>Lindia torulosa</i> Dujardin	.	.		.			.					.				
<i>Lophocharis oxysternon</i> (Gosse)				.											.	
<i>L. salpina</i> (Ehrb.)					.	.		.		.	.				.	
<i>Mytilina acanthophora</i> Hauer															.	
<i>M. bisulcata</i> (Lucks)			.													
<i>M. mucronata</i> (O.F.Müller)							.		.							.
<i>M. ventralis brevispinus</i> (Ehrb.)				.		.		.		.						.
<i>Notholca acuminata</i> (Ehrb.)	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.
<i>N. labis</i> Gosse	.														.	
<i>N. squamula</i> (O.F.Müller)	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.
<i>Paradicranophorus hudsoni</i> (Glascott)	.			.	.		.	.		.			.	.	.	.
<i>Platyas quadricornis</i> (Ehrb.)								.								
<i>Pleurotrocha</i> sp.			.													
<i>Polyarthra major</i> (Burckhardt)	.	.	.	.			.	.		.	.			.	.	.
<i>P. vulgaris</i> Carlin	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.
<i>Pompholyx complanata</i> Gosse	.									.		.				.
<i>P. sulcata</i> Hudson				.			.	.		.					.	
<i>Proales</i> sp.	.															
<i>Ptygura crystallina</i> (Ehrb.)	.															.
<i>Rotaria neptunia</i> (Ehrb.)	.					.	.	.		.		.			.	
<i>Rotaria</i> sp.										.	.	.				
<i>Squatinella rostrum tridentata</i> Schmarda									.							.
<i>Synchaeta pectinata</i> Ehrb.	.	.	.	.	.	.	.	.	.		.				.	.
<i>S. oblonga</i> Ehrb.	.		.	.				.			.				.	
<i>Testudinella parva</i> (Ternetz)	.							.		.						
<i>T. patina</i> (Hermann)	.	.	.	.	.		.		.	.	.	.			.	.
<i>Tetramastyx opoliensis</i> Zacharias										.	.					
<i>Trihocerca capucina</i> (Wierzejski et Zacharias)													.			.
<i>T. cylindrica</i> (Imhof)														.		
<i>T. dixon-nutalli</i> (Jennings)	.								.							
<i>T. elongata</i> (Gosse)														.	.	
<i>T. pusilla</i> (Lauterborn)	.	.		.	.				.		.			.		.
<i>T. rattus</i> (O.F.Müller)																.
<i>T. similis</i> (Wierzejski)	.	.	.	.			.			.						.
<i>T. stylata</i> (Gosse)								.								
<i>T. tigris</i> (O.F.Müller)															.	
<i>Trichotria pocillum</i> (O.F.Müller)		.		.			.									
<i>T. tetractis</i> (Ehrb.)								.								
Total:	64	32	37	37	31	24	40	48	54	55	43	24	17	25	46	51

Crustacea fauna of Transdanubian streams

TAXA	Sampling sites																	
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43		
CLADOCERA																		
Acroperus harpae (Baird)															•	•		
Alona affinis (Leydig)										•					•	•		
A. costata Sars				•											•			
A. guttata Sars															•	•		
A. quadrangularis (O.F.Müller)	•			•			•		•	•					•			
A. rectangula Sars	•			•			•	•	•	•				•	•	•		
Alonella nana (Baird)																•		
Bosmina coregoni Baird							•											
B. longirostris (O.F.Müller)	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•		
Ceriodaphnia megops Sars				•														
C. quadrangula (O.F.Müller)											•				•	•		
C. reticulata (Jurine)						•									•			
C. pulchella Sars				•														
Chydorus latus Sars	•						•									•		
C. sphaericus (O.F.Müller)	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•		
Daphnia cucullata Sars				•		•	•			•	•							
D. hyalina Leydig										•						•		
D. longispina O.F.Müller	•	•				•	•		•	•	•				•	•		
D. obtusa Kurz				•														
D. pulex Leydig em.Scourfield	•																	
Diaphanosoma brachyurum (Liévin)								•	•	•					•	•		
Disparalona rostrata (Koch)	•	•	•				•	•	•	•				•	•	•		
Graptoleberis testudinaria (Fischer)																•		
Iliocryptus sordidus (Liévin)	•	•						•										
Leptodora kindtii (Focke)																•		
Leydigia acanthocercoides (Fischer)															•			
L. leydigi (Schoedler)				•			•									•		
Macrothrix hirsuticornis Norman et Brady				•			•	•	•							•		
M. laticornis (Jurine)								•	•	•						•		
Moina micrura Kurz	•	•	•				•	•		•						•		
M. rectirostris (Leydig)							•											
Oxyurella tenuicaudis (Sars)																•		
Peracantha truncata (O.F.Müller)																•		
Pleuroxus aduncus (Jurine)	•	•			•		•			•					•	•		
Polyphemus pediculus (Linné)																•		
Pseudochydorus globosus (Blaird)							•											
Scapholeberis mucronata (O.F.Müller)							•		•							•		
Sida crystallina (O.F.Müller)																•		
Simoccephalus vetulus (O.F.Müller)	•		•	•			•			•					•	•		
Total:	12	7	9	8	3	5	17	9	10	14	5	1	1	4	16	27		

TAXA

Sampling sites

28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

COPEPODA

Calanoida

Eudiaptomus gracilis (Sars)

Eurytemora velox (Lilljeborg)

Cyclopoida

Acanthocyclops robustus Kiefer

A. vernalis (Fischer)

Cyclops strenuus Fischer

C. vicinus Ulianine

Diacyclops bicuspidatus (Claus)

Eucyclops macrurus (Sars)

E. serrulatus (Fischer)

E. speratus (Lilljeborg)

Macrocyclus albidus (Jurine)

M. fuscus (Jurine)

Megacyclops viridis (Jurine)

Mesocyclops leuckarti (Claus)

Paracyclops fimbriatus (Fischer)

Thermocyclops crassus (Fischer)

T. oithonoides (Sars)

Juvenilis form

Total:

7 4 4 3 2 7 8 6 5 3 5 2 2 1 9 11

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